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ORIGINAL ARTICLE

Cardiovascular risk factor trends in the Eastern Mediterranean region: evidence from four countries is alarming

Kaan Sözmen · Belgin Ünal · Olfa Saidi · Habiba Ben Romdhane · Niveen M. E. Abu-Rmeileh · Abdullatif Husseini · Fouad Fouad · Wasim Maziak · Kathleen Bennett · Martin O'Flaherty · Simon Capewell · Julia Critchley

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Abstract
Objectives Many Eastern Mediterranean countries are undergoing dramatic socioeconomic, demographic and life style changes and face noncommunicable disease (NCD) epidemics. We evaluated recent trends in major NCD risk factors in occupied Palestinian territories (OPT), Turkey, Syria and Tunisia.
Methods We searched published and unpublished sources for systolic blood pressure (SBP), diabetes, smoking, body mass index (BMI), and cholesterol trends for both men and women aged 35–84 in each country from 1995 to 2009.
Results Smoking prevalence was stable over time in Tunisia and Syria, but decreasing in Turkey (annual change −0.9 %) and OPT (annual change −0.7 %). Mean BMI (annual change of 0.1 % for Turkey, 0.2 % for OPT and Tunisia and 0.3 % in Syria) and diabetes (annual change of 0.3 % for Turkey, 0.4 % for OPT and Tunisia and 0.7 % in Syria) prevalence increased in each country. SBP levels increased slightly in Tunisia and Syria but decreased in OPT and Turkey.
Conclusions Recent risk factor trends are worrying. Good quality data on the extent and determinants of NCDs are essential to respond the changing health needs of populations with burgeoning NCD epidemics.

Keywords Trend · Risk factors · Cardiovascular diseases · Diabetes · Obesity · Smoking

On behalf of the MedCHAMPS Project team.

This article is part of the supplement "The rising burden of noncommunicable diseases in four Mediterranean countries and potential solutions".

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Introduction

Non-communicable diseases (NCDs) impose a large burden on human health worldwide. WHO defines NCDs as chronic non-transmissible diseases, generally of long duration and slow progression. The main types are cardiovascular diseases, cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma) and diabetes. Cardiovascular diseases (CVDs) are among the most prevalent type of NCDs. In 2010 there were more than 53 million CVD deaths globally and 65.5 % of all deaths were from NCDs worldwide (Lozano et al. 2012). The recent Global Burden of Disease (GBD) study reported that 54 % of disability adjusted life years (DALYs) worldwide were due to NCDs in 2010, an increase from 43 % in 1990. NCDs remain the leading cause of mortality in developed countries, although remarkable declines have been achieved in mortality rates in the last 20 years (Lozano et al. 2012). However, the burden of NCDs is increasing dramatically in low and middle income countries. In 2008, roughly four out of five NCD deaths occurred in low- and middle-income countries (WHO 2011b), a sharp increase from the figure reported (just under 40 %) in 1990 (Murray and Lopez 1997; WHO 2011a). Moreover, NCDs are having an effect on all age groups—already, one-quarter of all NCD-related deaths are among people below the age of 60 (WHO 2011a). The rise in the prevalence of NCDs is the result of complex interactions between health, economic growth and development, and it is strongly associated with universal trends such as ageing of the global population, rapid unplanned urbanization, and the globalization of unhealthy lifestyles. Major NCD and CVD risk factors overlap and include tobacco use, lack of physical activity, and unhealthy dietary patterns. As these behavioural risk factors can be difficult to measure accurately, resulting biological risk factors (such as body mass index, blood pressure and blood cholesterol levels) are often additionally reported. Whilst there are many other genetic and possibly immunological factors that may influence CVD risk, for the purposes of this study we are defining CVD risk factors as those behavioural and biological factors commonly measured e.g. in WHO STEPS surveys (smoking, physical inactivity, obesity, diabetes, total cholesterol and blood pressure) which we can compare over time and across countries (WHO 2011c).

Many Eastern Mediterranean countries are undergoing demographic and epidemiologic transitions and hence face NCD epidemics (Motlagh et al. 2009). Indeed, the World Health Organization (WHO) estimated that the Middle East and North Africa region would experience the greatest increase in NCD burden between 2010 and 2020 (WHO 2011b). A meta-analysis of cardiovascular disease (CVD) risk factors in Middle Eastern countries published in 2009 reported a high prevalence of obesity, diabetes mellitus, hypertension, and smoking (Motlagh et al. 2009). The studies included in this meta-analysis had substantial heterogeneity owing to differences in methodology and study populations. This study also only presented cross-sectional data and did not attempt to assess the recent trends in risk factors within the region. Good quality epidemiologic data on disease occurrence and risk factor trends are generally necessary to plan health services, to determine the public health priorities and respond efficiently to increasing NCD burden in developing countries. This may be particularly the case at present in Middle East and North African (MENA) countries because their health systems are undergoing transition to adapt both to the changing burden of disease and economic constraints as well as socio-political transformation in some countries.

This study was conducted as part of a Seventh Framework of European Union-funded multinational project titled MedCHAMPS (Mediterranean Studies of Cardiovascular disease and Hyperglycaemia: Analytical Modelling of Population Socio-economic transitions). The project aimed to analyse and model changes in risk factors and CVD mortality rates in Syria, Occupied Palestinian territories (OPT), Tunisia and Turkey. http://research.ncl.ac.uk/medchamps/ (Bowman et al. 2012; Maziak et al. 2013). The data presented here were used partly to generate the IMPACT CHD models in these four countries (Abu-Rmeileh et al. 2012; Maziak et al. 2013; Rastam et al. 2012; Saidi et al. 2013; Unal et al. 2013). The aim of this current study was, therefore, to evaluate recent trends in CVD risk factors in occupied Palestinian territory (OPT), Turkey, Syria and Tunisia based on the best data available for years 1995–2009.

Methods

Study area

Turkey is located at the crossroads of Europe and Asia with a population of 76 million; 70 % living in urban areas. Syria is located to the South of Turkey with 21 million inhabitants; 56 % living in urban areas (at the time of data collection, just prior to the start of the uprising). Tunisia (10.9 million and 67 % living in urban areas population) and Turkey are considered upper-middle income countries according to the World Bank whilst Syria and Palestine (70 % living in urban area) are classified as lower-middle income countries with a low human development index value. Turkey is the largest of the countries in this study. Syria and Tunisia are similar in scale but 4 times smaller than Turkey (185 and 163 km^2 respectively) (WHO 2014).

Target population

In our study adults aged 35–84 formed the target population. We selected this age band since data are usually not available for people over 85 and for comparability with other epidemiological studies elsewhere (Kuulasmaa et al. 2000). We gathered data for both men and women separately. This is important in the specific context of NCDs in the MENA region due to gender socio-cultural issues which impact CVD risk factors differently for women and men.

Measurements and indicators

We used mean values [and 95 % confidence intervals (CI)] for indices that are measurable such as BMI, blood cholesterol, and systolic blood pressure instead of prevalence rates (of obesity, hypercholesterolaemia or hypertension) as our main outcome because evidence has demonstrated that the association between CVD and these risk factors is continuous (Prospective Studies et al. 2009). For smoking and diabetes prevalence data were collected. In most cases there was no data analysis of subject-level data, but only national or regional age-gender specific values were available. We contacted study authors to request data or additional results when the risk factor definitions or age bands published were not consistent with our definitions.

Data sources and study selection

Data on each risk factor were collected by the research teams of project countries. Potential data sources including surveys, national statistics reports or registers were evaluated using a pre-defined data collection form developed iteratively by the project members. This included the definitions and cut off points of risk factors, stratified by gender and 10 year age group (Electronic supplementary material (ESM) Appendix 1—Data collection form). These forms were prepared using information from Preferred Reporting Items for Systematic Reviews (PRISMA) and Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines (Vandenbroucke et al. 2014). Data on major cardiovascular risk factors (smoking, diabetes, BMI, total cholesterol and systolic blood pressure) were searched systematically from international (MEDLINE/PubMed) and national electronic databases using specific key words for each risk factor and partner country. Titles and abstracts were examined for inclusion by two independent reviewers. Bibliographies of retrieved articles were scanned for additional articles. National survey reports and regional studies were also screened. Websites of national professional associations such as cardiology, diabetes and internal medicine were checked in each partner country. Congress abstracts and reference list of key papers were also checked manually. Experts working on cardiovascular diseases and diabetes were contacted to find additional unpublished studies (ESM Appendix 2- Search method and data sources searched).

Data on study design, participants, diagnostic criteria, local or national setting (representativeness), study size, sampling method, bias, strength and weakness of studies were assessed and extracted in specially designed data collection forms. Studies were required to conform to the following criteria: (a) a sample that included adults aged >25, (b) cohort or cross-sectional design (c) original studies that presented the data on the prevalence of diabetes, smoking, blood pressure levels, total cholesterol levels or mean BMI values stratified by age and gender (d) study setting should be national or nationally representative. Studies that fulfilled these criteria were used to estimate the trends.

We included population surveys that used standardized methods, reported the prevalence or mean values of risk factors including smoking, systolic blood pressure, diabetes mellitus, total cholesterol, and BMI. For reporting of individual risk factors, the following criteria were required: (a) body mass index (BMI), calculated as weight (kilogram)/height (square metre) and, (b) diabetes mellitus was defined based on either fasting glucose or glucose tolerance cut-point (American Diabetes 2011).

A detailed list of data sources from each country and critical appraisal notes for data sources has been published elsewhere (Abu-Rmeileh et al. 2012; Maziak et al. 2013; Rastam et al. 2012; Saidi et al. 2013; Unal et al. 2013) and is available in ESM Appendix 3 provided with this manuscript.

Data analysis

BMI calculated as weight (kilogram)/height (square metre), systolic blood pressure (mmHg) and total cholesterol (mg/dl) levels were collected as continuous variables and the change in mean values of these variables were used for two endpoints. Data on smoking and DM were collected as rates. Final year rates were standardized for age using the direct standardization method. Age and gender-specific rates from study populations were applied to the base year population distribution based on census data for each country to eliminate differences in observed rates that may result from differences in population composition. To make the trends with different starting points comparable, linear interpolation was made backward or forward if necessary. While estimating the changes in risk factors we used the linear regression method to interpolate missing data for time points. We assumed the same average annual % change for age/gender groups. To evaluate the trends in risk factor levels, 95 % confidence intervals (CI) for base and final years were presented. Trends were presented by gender among adults aged between 35 and 84 years, by 10 year age group. Microsoft Excel 2010 software was used for the analysis.

Table 1 Changes in smoking and diabetes prevalence in occupied Palestinian territories, Syria, Tunisia and Turkey for period 1995–2009 by gender

	Smoking, % (95 %CI)			Diabetes, % (95 %CI)		
	Men	Women	Total	Men	Women	Total
Occupied Palestinian territories						
1998	49.5 (45.7–57.3)	10.8 (8.7–12.9)	29.4 (27.1–31.7)	13.4 (10.8–16.0)	14.2 (11.8–16.6)	13.8 (12.1–15.5)
2009	39.5 (37.8–41.2)	3.7 (3.2–4.2)	21.5 (20.6–22.4)	18.9 (17.5–20.3)	16.5 (15.5–17.5)	17.7 (16.9–18.5)
% Change	−20.2	−65.3	−26.8	40.7	16.3	28.0
Average change/year[a]	−0.9	−0.6	−0.7	0.5	0.2	0.4
Syria						
1996	47.9 (44.1–51.7)	11.6 (9.4–13.8)	27.4 (25.1–29.7)	12.5 (10.0–15.0)	16.0 (13.5–18.5)	14.3 (12.5–16.1)
2006	51.6 (48.9–54.3)	17.3 (15.3–19.3)	31.5 (29.8–33.2)	18.7 (16.8–20.6)	23.1 (21.1–25.1)	20.9 (19.5–22.3)
% Change	7.7	48.7	14.9	49.4	44.4	46.7
Average change/year	0.4	0.6	0.4	0.6	0.7	0.7
Tunisia						
1997	42.1 (41.1–43.1)	1.8 (1.5–2.1)	21.7 (21.1–22.3)	13.5 (12.4–14.6)	14.8 (13.9–15.7)	14.1 (13.4–14.8)
2009	37.3 (36.5–38.1)	5.2 (4.9–5.5)	20.9 (20.5–21.5)	20.2 (19.5–20.9)	18.1 (17.6–18.6)	19.1 (18.7–19.5)
% Change	−11.4	184.9	−3.8	50.3	22.2	35.3
Average change/year	−0.4	0.3	−0.1	0.6	0.3	0.4
Turkey						
1995	44.6 (44.0–45.2)	9.6 (9.3–9.9)	27.0 (26.6–27.4)	14.5 (14.1–14.9)	16.2 (15.8–16.6)	15.3 (15.0–15.6)
2008	24.6 (24.1–25.1)	7.2 (6.9–7.5)	15.7 (15.4–16.0)	17.5 (17.0–18.0)	19.9 (19.5–20.3)	18.7 (18.4–19.0)
% Change	−44.8	−25.3	−41.9	21.0	22.9	22.2
Average change/year	−1.5	−0.2	−0.9	0.3	0.4	0.3

[a] Value last year of period segment − value first year of period segment)/value first year of period segment

Results

Country level data were limited in all countries between 1995 and 2009. In OPT a study in both rural and urban areas of Ramallah governorate was used as the main source for the early year (1996). In Syria the main data source for risk factors is Aleppo Diabetes Study (2006). A STEPWISE survey was also carried out in Syria in 2003. Tunisia has risk factor data from surveys carried out in 1976, 1997 and 2009 in main districts including Tunis and Ariana. Turkey has a national adult CVD risk factor survey carried out in 1990 (Onat 2001) and the number of national surveys (Altun et al. 2005; Sanisoglu et al. 2006; Satman et al. 2002, 2013) increased substantially in the last 10 years.

Smoking prevalence was high among men at all time points, ranging from 42 % (Tunisia) to 49 % (OPT) in the mid-1990s. Smoking prevalence was lower in women, ranging from 1.8 % (Tunisia) to 11.7 % (Syria) in women. Smoking prevalence decreased in Turkey and OPT but persisted in Tunisian men and increased in Syria by the late 2000s. Smoking prevalence reached 52 % in men in 2006 in Syria—the highest among the four countries. Turkey had the lowest smoking prevalence in men (24.6 %) in 2008. In the same period smoking prevalence increased by 49 % in women in Syria and almost doubled in Tunisian women (from 11.6 %; 95 % CI 9.4–13.8) in 1996 to 17.3 %; 95 % CI 15.3–19.3 in 2006) (Table 1; ESM Appendix-Fig. 1), albeit from a low starting level. While the smoking rates decreased by 0.7 % in OPT and 0.9 % in Turkey annually, smoking rates increased by 0.4 % in Syria.

In all four countries diabetes prevalence increased among both men and women over this decade. Syria and Tunisia experienced the highest increase (approximately 50 %) in diabetes prevalence in men (Table 1; ESM Appendix-Fig. 2). In general diabetes prevalence was relatively consistent and high across the four countries; ranging from 17.7 % in OPT to 20 % in Syria in the late 2000s.

Mean BMI increased in all four countries in both men and women. Syria experienced the highest (11 %) increase in women. Systolic blood pressure (SBP) showed a decreasing trend in Turkey (1.9 %) and OPT (1.4 %), whilst it increased by 6.5 % in Syria over this 10-year period. In Tunisia mean SBP increased by 3 % in men but decreased by 2.3 % in women between 1997 and 2009. Mean total cholesterol decreased in Tunisia and in OPT and persisted in Turkey. However, cholesterol levels increased both in men and women in Syria between 1996 and 2006 (Table 2; ESM Appendix-Fig. 5).

Table 2 Changes in mean body mass index, systolic blood pressure and total cholesterol levels in occupied Palestinian territories, Syria, Tunisia and Turkey for period 1995–2009 by gender

	Body mass index (kg/m^2)			Systolic blood pressure (mmHg)			Total cholesterol (mmol/L)		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Occupied Palestinian territories									
1998, Mean (95 %CI)	26.7 (26.1–27.3)	29.1 (28.3–29.9)	27.9 (27.4–28.4)	128.0 (125.6–130.4)	125.5 (122.8–128.2)	126.7 (124.9–128.5)	5.3 (5.2–5.4)	5.3 (5.1–5.5)	5.3 (5.2–5.4)
2009, Mean (95 %CI)	28.4 (28.0–28.8)	30.8 (30.5–31.1)	29.7 (29.5–29.9)	125.4 (123.5–127.3)	124.3 (123.1–125.5)	124.9 (123.9–125.9)	5.1 (5.0–5.2)	5.1 (5.0–5.2)	5.1 (5.0–5.2)
% Change	6.4	5.7	6.0	−2.0	−0.9	−1.4	−4.1	−4.2	−4.2
Average change/year[a]	0.2	0.2	0.2	−0.2	−0.1	−0.2	0.0	0.0	0.0
Syria									
1996, Mean (95 %CI)	27.3 (26.7–27.9)	29.3 (28.5–30.1)	28.7 (28.2–29.2)	130.1 (127.7–132.5)	125.4 (122.7–128.1)	127.8 (126.0–129.6)	5.3 (5.2–5.4)	5.4 (5.2–5.6)	5.3 (5.2–5.4)
2006, Mean (95 %CI)	30.1 (29.3–30.9)	33.5 (32.3–34.7)	31.5 (30.5–32.5)	136.3 (132.7–139.9)	135.9 (131.7–140.1)	136.1 (132.2–140.0)	5.5 (5.4–5.5)	5.8 (5.7–5.9)	5.6 (5.5–5.7)
% Change	7.5	11.3	9.9	4.7	8.4	6.5	3.5	7.7	5.6
Average change/year	0.3	0.4	0.3	0.6	1.1	0.8	0.0	0.0	0.0
Tunisia									
1997, Mean (95 %CI)	25.0 (24.9–25.1)	27.7 (27.4–28.0)	26.4 (26.3–26.5)	131.9 (131.5–132.3)	135.5 (135.0–136.0)	133.7 (133.4–134.0)	4.7 (4.6–4.8)	4.9 (4.8–5.0)	4.8 (4.7–4.9)
2009, Mean (95 %CI)	27.4 (26.8–28.0)	29.2 (28.8–29.6)	28.4 (28.1–28.7)	136.0 (134.2–137.8)	132.5 (131.3–133.7)	134.2 (133.2–135.2)	5.1 (5.0–5.2)	4.3 (4.2–4.4)	4.7 (4.6–4.8)
% Change	9.5	5.3	7.4	3.1	−2.3	0.4	10.6	−10.7	−0.5
Average change/year	0.2	0.1	0.2	0.3	−0.3	0.0	0.0	0.0	0.0
Turkey									
1995, Mean(95 %CI)	26.1 (26.0–26.2)	28.8 (28.7–29.9)	27.4 (27.3–27.5)	123.9 (123.4–124.4)	129.6 (129.1–130.1)	126.8 (126.4–127.2)	4.9 (4.8–5.1)	5.0 (4.9–5.0)	5.0 (4.9–5.0)
2008, Mean (95 %CI)	27.9 (27.8–28.0)	30.1 (30.0–30.2)	29.0 (28.9–29.1)	123.4 (122.9–123.9)	125.8 (125.4–126.2)	124.4 (124.1–124.7)	4.9 (4.9–4.9)	5.0 (5.0–5.0)	5.0 (5.0–5.0)
% Change	6.9	4.6	5.9	−0.4	−3.0	−1.9	0.3	0.4	0.3
Average change/year	0.1	0.1	0.1	−0.0	−0.4	−0.2	0.0	0.0	0.0

[a] (Value last year of period segment−value first year of period segment)/value first year of period segment

Discussion

The present study identified and critically appraised existing data from local CVD risk factor surveys and disease registers and assessed the change in main risk factors during last decade in Syria, OPT, Tunisia and Turkey. In general population statistics and projections were available, complete, accurate and accessible in the study countries (Abu-Rmeileh et al. 2012; Rastam et al. 2012; Saidi et al. 2013; Unal et al. 2013).

Good quality, nationally representative data are essential to evaluate the trends in NCD epidemic and to predict future trends. However, data on major NCD risk factors from earlier decades (1980s or early 1990s) are missing in all the countries except Tunisia. In addition, the quality of the data and representativeness of the population in older studies are questionable. For example the well-cited Turkish Adult Risk Factor Survey did not have a real sampling frame and the sample was selected from volunteers (Onat et al. 1993). The NCD risk factor data from OPT only; come from West Bank and most data from Syria come from the Aleppo Diabetes Study. More recently, WHO STEPWISE surveys seem to provide good national data for risk factors since they have been carried out using validated and standardized methods (WHO 2011c). STEPWISE Surveys done in Syria and OPT by the MOH and WHO on 2003 and 2006, respectively, are the main national surveys in these countries. Although Turkey and Tunisia did not have STEPS surveys these countries had nationally representative data on NCDs and risk factors (MOH 2007, 2010; Saidi et al. 2013; Sanisoglu et al. 2006; Satman et al. 2002, 2013) that could provide epidemiologic evidence for decision making. It was also possible to obtain breakdowns by key demographic features including age, gender, urban/rural location but less so for ethnicity and socioeconomic status.

These countries showed rapid risk factor and mortality changes which might be the result of economic and nutritional transitions in the Middle East. In 2012 Human Development Index (HDI) ranking for OPT, Syria, Tunisia and Turkey was, respectively, 110, 116, 94 and 90 (over 187 ranked countries); Turkey and Tunisia were counted as having high human development, while OPT and Syria have medium development. Between 2010 and 2012 average annual HDI growth was higher in Turkey (0.95), followed by Tunisia (0.86), and Syria (0.70). Gender Inequality Index rankings (lower rank means higher gender inequality) were 118, 46 and 68, respectively, (over 150 ranked countries) (UN 2014). Data for OPT were not available for these United Nations rankings.

Our analyses demonstrate very heterogeneous trends in major CVD risk factors, even among neighbouring countries with shared similar culture and life style. Recent analyses of global CHD mortality data from the WHO database have also demonstrated the substantial heterogeneity in CHD mortality trends (emergence and waning of the epidemic) between culturally and geographically similar countries (Mirzaei et al. 2009). During the given periods for each country, CHD mortality in Turkey and OPT decreased by 25 % in OPT and by 17 % in Turkey, and CHD mortality rates rose by 30 % in Tunisia and by 56 % in Syria. While similar rises in CHD mortality have been observed in many other middle income countries, Turkish CVD mortality rates resemble Central and Eastern European countries where CVD mortality rates have been declining over the last two decades (Dinc et al. 2013).

Smoking prevalence remained constant in Tunisia and Syria but started to decrease in OPT and Turkey. Smoking prevalence rates are still high in the four countries compared with the countries in America, Europe and Australia (Ng et al. 2014). Our estimates of trends in smoking are in the same direction as the GBD 2012 estimates, where estimated age-standardized prevalence of daily tobacco smoking declined by 25 % in men and by 42 % in women between 1980 and 2012 (Ng et al. 2014). In the same study the mean annualized rate of decline was 2.3 % between 1997 and 2006 in women and 1.8 % in total in developing countries. Annual rate of decline rates in Turkey, Palestine, Syria (0.9, 0.7 and 0.1 %) were lower than that reported by NG et al (2014). This may be because of the difference in age groups; we analysed data from middle aged and older adults (age 35+) whilst Ng et al. (2014) included all adults over 15 years. Declines in smoking rates have been higher among younger people over the last three decades Ng et al. The increasing smoking trends in Syrian men and women and Tunisian women need special attention. The reason for declining smoking trends in OPT could be due to the antismoking law which was initiated in 2005 (Abu-Rmeileh et al. 2012). According to the Turkish part of Global Adult Tobacco Survey (GATS) conducted in 2008 and 2012, smoking prevalence significantly decreased among adults from 31.2 % (16.0 million) in 2008 to 27.1 % (14.8 million) in 2012 in Turkey. This represents a 13.4 % relative decline in smoking prevalence (13.5 % decline for males; 13.7 % decline for females) (Kostova et al. 2014). These findings may be attributed to implementation of strict tobacco control policies in Turkey. However, in Syria, lack of effective tobacco control policies and an unstable political situation could be the reason for the rise in smoking prevalence (Rastam et al. 2012).

In all countries average BMI is higher than 25 kg/m^2 (the definition of overweight), and in three of the four countries (all except Tunisia) mean BMI in women is already above 30 kg/m^2; the cutoff for obesity (Consultation 2004). Our analysis showed that the mean BMI increased by 3, 3, 3 and 2 kg/m^2 per decade in Syria, OPT, Tunisia and Turkey, respectively. The increase was higher in men compared with women in Tunisia and Turkey. In Syria and OPT, women had higher relative increases in BMI compared with men. Our estimates for mean BMI trends are similar to those reported by the Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group work (Finucane et al. 2011). In that analysis they reported 0.9 kg/m^2 increase in mean BMI per decade in men and 1.1 kg/m^2 increase in women aged 20 years and older in the Middle East and North Africa Region (Finucane et al. 2011). However, according to our results Syria showed the highest increase in mean BMI; a 2 kg/m^2 increase in men and 3 kg/m^2 increase in women over a decade. A substantial increase in obesity, from 17 to 28 %, was also reported for Lebanese adult population between 1997 and 2009 (Nasreddine et al. 2012). This increasing obesity trend is most likely due to rapid economic and nutritional transitions in this region.

Mean SBP decreased in women in Tunisia, Turkey and OPT but increased in Syria. A recent analysis also reported a decreasing trend in mean SBP in the MENA region between 1980 and 2008 (Danaei et al. 2011).

Mean cholesterol decreased only in OPT by 4.2 %. In Tunisia and Turkey mean total cholesterol levels changed by <1 %. In Syria cholesterol levels increased both in men (by 5.5 %) and women (by 5.8 %) between 1996 and 2006. Similarly a systematic review that included population surveys from 199 countries globally concluded that very little change in mean total cholesterol was observed between 1980 and 2008; falling by <0.1 mmol/L per decade in men and women (Farzadfar et al. 2011). While mean BMI increased in Tunisia, Turkey and OPT, SBP showed a decreasing trend in these countries and cholesterol levels decreased or were stable. This could be the result of increased uptake of treatments in the community for high blood pressure and hyperlipidemia. Decreases in smoking and blood pressure levels explained 51 and 48 % percent of the fall in CHD mortality rates in OPT and Turkey, respectively (Abu-Rmeileh et al. 2012; Unal et al. 2013). On the other hand increases in SBP in Syria and Tunisia increased CHD mortality by 32 and 24 %, respectively, on CHD mortality (Rastam et al. 2012; Saidi et al. 2013).

This increasing obesity and diabetes trend is most likely due to rapid economic and nutritional transitions in this region, in particular, increased consumption of a westernized diet such as fast food, and more sedentary lifestyles following urbanization. For example, between 1971 and 1997, calorie intakes rose by over 40 % in Syria and Tunisia, (from 2,340 to 3,350 calories in Syria and from 2,280 to 3,280 calories in Tunisia). According to the FAO statistics, daily calorie intake per capita in 2005–2007 was 3,480 calories in Turkey and 3,310 in Tunisia. Fat intakes similarly increased by over 60 % over the same time period (Musaiger 2002). It is also evident that weight gain (measured as the change in BMI) resulted in higher risk of developing DM (relative risk was 1.25 for each unit of BMI gain in adults) (Schienkiewitz et al. 2006). Physical activity levels are also very low; according to a recent Turkish study 71.9 % of individuals over the age of 12 did not take any physical activity in the last week (MOH 2014).

Even modest changes in population risk factor levels may result in significant changes in population mortality. Coefficients estimated from large meta-analyses of prospective cohort data, such as the Prospective Studies Cohort Collaboration, have estimated the population impact of relatively small changes in risk factors. For example an approximate 4 mmHg reduction in SBP (seen in Turkish women) would be expected to result in about a 20 % reduction in hazard of CHD mortality at a population level (Lewington et al. 2002). Similarly, a large meta-analysis has demonstrated that even small increases in BMI, such as a 1 U increase, would be expected to increase CHD mortality by 3–4 % in younger adults (Bogers et al. 2007).

This analysis has several strengths. First we performed comprehensive data searching and critical appraisal of data sources by the scientists in individual countries. Our search included unpublished studies and reports. In most cases age–gender-specific country-level aggregated data were available. However, in many cases only broad age groups were available, or results not published yet, and in these cases we requested and obtained individual study data to generate the estimates we needed. All data sources were critically evaluated and statistical methods including linear interpolation were used to fill in the missing data for time points assuming the same average annual % change. This analysis also has several limitations. One potential limitation could be differences between studies including sample size, study quality, study design, diagnostic criteria, and geographical distribution in the studies which might have an impact on risk factor prevalences. Second, using regional instead of national data for some countries such as in Syria for different time points may limit the generalizability of the findings. We did not include two main risk factors such as physical activity and healthy nutrition because of scarcity of the data in these countries. For example there is only one published national study in Turkey (MOH 2014) measuring these two conditions at population level. We have assumed a linear increase or decrease in risk factors. However, trends for prevalences or mean values may follow less than linear or nonlinear patterns. We have added the 95 % CI for each risk factor (where available) for the base and final years for each country. We did not analyse sample data (only cumulative reported data) which make a more comprehensive evaluation of statistical significance of change in risk factors impossible. Last, for each risk factor a different number of data points were used in this study. For example while Turkey had four data points for smoking prevalence, Tunisia and OPT had only two. On the other hand for estimating blood pressure levels; Turkey used two data points, but Tunisia had three data points. This might have an impact on slope of the trends (ESM). Variations in prevalence of CVD risk factors such as income, education, urban–rural setting was not assessed in this study, however, evidence suggest that socioeconomic inequalities exists in distribution of risk factors and NCDs (Hassoy et al. 2014; Sozmen and Unal 2014). Another limitation is that although these countries may have similarities in culture and lifestyle, they differ in terms of gender inequality and economic development which may reduce comparability of trends across countries; however, within country comparison is generally more robust.

Conclusion

Existing data already suggest worrying trends especially in obesity and diabetes that should be taken into account as a public health emergency in these diverse Eastern Mediterranean countries. However, epidemiologic data which is necessary to respond efficiently to this increasing NCD burden in developing countries tend to be either nonexistent or limited. Hence, in all countries periodic surveys of CVD risk factors using standardized and consistent methods in the general population are required to provide data for evidence-based policy making to reduce future burden of NCDs and its risk factors. Policy making also requires data to support decision modelling and forecasting of future burden. Decision modelling itself can help in refining the data needs and helps to set the national priorities in terms of research by integrating research and decision as a continuous improvement cycle.

We also recommend developing a web page like the UK British Heart Foundation's HeartStats site http://www.heartstats.org) to present data sources on NCDs and risk factors for the MEDCHAMPS project countries and for the countries in the Mediterranean Region. This shared web source can help the countries to extrapolate the findings to their own country and support evidence-based health policy making.

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